ECONOMICS OF SOLID WASTE MANAGEMENT IN TIRUNELVELI CORPORATION

Introduction

Municipal solid waste management (MSWM) is one of the major environmental problems in Indian cities. Improper management of municipal solid waste (MSW) causes hazards to inhabitants. Solid wastes other than hazardous and radioactive material are often referred to as Municipal Solid Waste (MSW). Municipal Solid Waste is useless unwarranted material discharge as a result of human activity. Most commonly, they are solids, semi solids or liquids in containers thrown out of houses, commercial or industrial premises (Nyangababo and Hamya, 1980).

Economic development, urbanization and improved living standards in cities increase the amount and complexity of solid waste. This result in degradation of the urban environment, puts stress on natural resources, and undermines sustainable development. Inefficient management and disposal of municipal solid waste (MSW) is the cause of environmental degradation in most developing cities. Improper disposal of waste leads to obnoxious conditions and the spread of communicable diseases. Cleanliness is an indicator for development, which is adversely influenced by improper solid waste disposal.

The quality and quantity of MSW generated by a particular community will vary according to their socio-economic status, cultural habits, urban structure, population and commercial activities. Asian countries are facing MSWM problems due to the rapid growth in MSW generation rate. The total quantity of waste generated by 23 metro cities in India was 30,000 tpd (tonnes per day) in 1999, which has increased considerably to about 52,000 tpd (Inance et al, 2004). Government bodies at
all levels (central, state and municipal) are taking proactive steps to improve the municipal solid waste scene in India. The Government of India issued new rules that regulate the MSWM (MoEF, 2000) at the local level.

The composition of solid wastes has been changing dramatically over time, and volume has been continuously increasing. Pressing problems connected with this growing amount of material have been recognized in many cities and metropolitan areas, and efforts are being made to find solutions. However, solid waste problems are by no means confined to cities and large metropolitan areas. Failure to recognize solid waste problems in rural areas may be one reason why open dumps, open-dump burning, and littering occur and are making many rural areas lose their advantage over cities in environmental quality. As urban frontiers penetrate deeper into rural areas, solid waste problems in rural areas will become more critical in recent days. To add to the problems, sparsely populated rural areas are becoming prime candidates for location of disposal sites for wastes generated in large metropolitan areas. The need for attention to solid wastes is accentuated by the fact that government in rural areas are not well equipped in manpower, expertise, and other resources to deal with solid waste problems like the governmental units of cities and larger metropolitan areas.

MSW presents an important problem to many cities and towns across the world due to lack of space. One way to solve this is to carry MSW long distances from urban areas where more free space is available for its final disposal. But even then, there is also the fear of groundwater contamination because of poorly constructed landfills, and of air pollution from incineration of garbage. Contamination is an ever-present issue that the authorities face. MSW is particularly a big problem in places with high rates of population growth and lack of space for the construction of landfills. It is fundamental
to find efficient ways to treat MSW. The improvement in environmental quality these treatments produce may lead to increases in individual and social welfare for which, in principle, there should be a positive willing to pay (Hartwick et al., 1998).

Human activities create waste, and it is the way these wastes are handled, stored, collected and disposed of, which can pose risks to the environment and to public health. Where intense human activities concentrate, such as in urban centers, appropriate and safe SWM are of utmost importance to allow healthy living conditions for the population. This fact has been acknowledged by most of the governments, however many municipalities are struggling to provide even the most basic services. Typically one to two thirds of the solid waste generated is not collected (World Resources Institute, et al., 1996). As a result, the uncollected waste, which is often also mixed with human and animal excreta, is dumped indiscriminately in the streets and in drains, so contributing to flooding, breeding of insect and rodent vectors and the spread of diseases (UNEP-IETC, 1996). Most of the municipal solid waste in low-income Asian countries which is collected is dumped on land in a more or less uncontrolled manner. Such inadequate waste disposal creates serious environmental problems that affect health of humans and animals and cause serious economic and other welfare losses.

Waste management is a problem in urban and rural areas. Many areas, particularly developing countries like India, still have inadequate waste management; poorly controlled open dumps and illegal roadside dumping remain a problem. Such dumping spoils scenic resources, pollutes soil and water resources, and is a potential health hazard to plants, animals and people. According to the United Nation’s Centre for Human Settlements, only between 25 and 55 per cent of all waste generated in large
cities is collected by municipal authorities. At least 60 per cent of the countries that submitted national reports to the United Nations in advance of the 1992 Earth Summit said that solid waste disposal was among their biggest environmental concerns. The importance of proper solid waste management is one of the prime functions of the civic body, as improper management of solid wastes is a cause of much discomfort. Since waste management is the fundamental requirement for public health, Article 48-A of the Indian Constitution establishes the responsibility of the state to manage these wastes properly.

Realizing the need for proper and scientific management of solid waste, the Municipal Solid Waste (Management & Handling) Rules, 2000 were notified by the Ministry of Environment and Forests, Govt. of India. The objective of these rules was to make every municipal authority responsible for the implementation of the various provisions of the rules within its territorial area and also to develop an effective infrastructure for collection, storage, segregation, transportation, processing and disposal of MSW. The indiscriminate dumping of municipal solid wastes in water bodies and low lying areas is a common practice followed by most of the municipalities with no consideration of its effect on the environment. Moreover, the lack of basic information regarding generation, collection, transportation and disposal of solid waste is noted. The mandatory requirements of the MSWM 2000 rule are,

- Source segregation and storage at source
- Door to door collection
- Abolition of open storage
- Daily sweeping of the street
- Transportation of waste in covered vehicles
• Waste processing by composting or energy recovery
• Disposal of inert by sanitary landfilling

State governments are involved through the State Pollution Control Boards (SPCBs) which enforce pollution control laws and local municipalities to comply with the new rules.

Today, the solid waste problem includes inadequate waste collection systems, open dumping and other forms of improper final disposal and the resulting environmental pollution, scavenging at landfill sites by waste pickers, and illegal dumping. These problems are being aggravated by growing waste generation rates associated with economic growth, increases in consumption levels, and the transition to mass consumption lifestyles. There is concern that these problems, if left unaddressed, will become a serious challenge for generations to come. This concern has been shared by the international community since the 1990s. However, it seems that this has not been the case in developing countries in general and India in particular.

Therefore, the severity of Solid Waste Management is crucial and inevitable in the modern world. In case of Tirunelveli, the sixth Municipal Corporation in Tamil Nadu which generates more solid waste in recent days due to increasing urbanization and consequent urban growth with more and more new colonies and extension areas, and changing life style of the people have tremendously increased the solid waste problems. Corporation found it difficult to clean all areas regularly. Based on the discussion in various forums, Corporation started concept of promoting residential associations to take up sanitation in their colonies by engaging private sanitary workers. Under this circumstances, this kind of environmental problems cause greater
concern over the solid waste management which stimulate to carry out research and thereby to promote effective and efficient way of maintaining solid waste management by the Municipal corporation. This study would also estimate further to introduce Willingness to Pay (WTP) in order to improve solid waste management services provided to the public by way of introducing contingent valuation survey. However, survey results would also significantly facilitate to fix tariff ceiling to each and every household based on the service provided towards solid waste management by the Corporation.

As of 2011 India Census, Tirunelveli district has a population of 30,72,880. Male constitutes 15,18,595 (49.42%) of the population and female 15,54,285 (50.58%). The decadal growth rate of population has increased from 8.9 percent to 13.7 percent. The city has an average literacy rate of 78%, higher than the national average of 59.5%: male literacy is 83%, and female literacy is 73%. In Tirunelveli, 10 percent of the population is less than 6 years of age. Among the Municipal Corporations, Tirunelveli has been identified with a gender ratio of urban agglomeration is 20.22 percent. The city spreads over an area of 108.65 square kilometers. The population density of the city has increased from 3781 persons per square kilometers in 2001 to 4370 persons per square kilometer in 2011.

Tirunelveli District is the pride of Tamils. The crawling clouds of the Western Ghats, the picturesque Pothigai hills and the Courtallam waterfalls are the special features which make Tirunelveli unique. However, all these natural beauty of the City has deteriorated today due to alarming level of increasing solid waste generation produced by burgeoning population without proper solid waste management system in the Corporation. Today the perennial river, Tamirabarani, is highly polluted by
domestic solid waste dumping without improper treatments which lead to the increase of waterborne diseases and thereby an increase in the health expenditure of the inhabitants of the Corporation.

The core aim of the research is to assess the economic impact of Solid Waste Management in Tirunelveli Corporation in general and its impact on human health in particular. The economic impact refers to the evaluation of work day’s loss and health impact due to solid waste generation in the Corporation. The concept of environment in a developing nation brings a vision of a society where settlements in urban area would be healthy, drinking water will be easily accessible and free from disease – carrying germs, sanitary conditions will be at an acceptable level and the urban society will be able to provide opportunities to its members to live hale and healthy. All these complexities pose a greater challenge to the policy makers on how they would solve the crucial problem of Solid Waste Management without affecting the environment. There is no proper solid waste management measure available. Existing legal measures are helpless to maintain solid waste management in an effective way.

According to the United Nation’s Centre for Human Settlements, only between 25 and 55 per cent of all waste generated in large cities is collected by municipal authorities. For instance, waste generation every day in Tirunelveli Corporation was estimated to be 161.44 M.T. out of which 53.44 M.T. was left uncollected. Out of the total amount of waste generated, 33.10% remain uncollected and the rest 66.90% was collected. The remaining uncollected solid waste creates huge environmental problems to city dwellers and this becomes a daunting task to the Corporation. This study would address a feasible solution to manage solid waste management in an efficient way without affecting the environment.
Objectives of the study

1. To study the existing practices of solid waste management and its environmental impacts on health in Tirunelveli City.

2. To estimate the cost incurred due to Solid Waste Management by the Corporation of Tirunelveli.

3. To estimate respondents Willingness to Pay (WTP) to improve Solid Waste Management in Tirunelveli Corporation by using Contingent Valuation Method.

4. To assess knowledge, attitudes, and practices of the respondents towards solid waste management.

5. To suggest suitable measures in order to improve solid waste management by the Corporation.

Methodology

Tirunelveli Corporation has been divided into four zones, such as Tirunelveli, Thachanallur, Palayamkottai and Melapalayam. Besides, these zones were divided into 55 wards. Each ward is divided according to the size of population not exceeding a maximum of 7,500 per ward. In order to give equal representation to every zone and to every ward of the Tirunelveli Corporation, it was decided to collect 510 sample households (30 samples per each unit) in Tirunelveli Corporation. The present study is based on both primary and secondary sources of data. Primary data was collected through questionnaire administration. The sample selection was executed based on stratified random sampling of 510 household respondents. The researcher has used
two types of questionnaires and first type of questionnaire focus on the respondents’
demography, environmental quality, and household willingness to pay, door-to-door
collection, available infrastructure, frequency of garbage collection, level of
satisfaction of the consumers, improved solid waste management, health and
environmental damage. The second type of questionnaire contains the institutional
responses i.e. (the Corporation) of annual budget for solid waste maintenance, solid
waste collection, transport and disposal during the periods of 2003-2010. In addition,
data were collected about the staff employed for each unit, solid waste management
regulations, bylaws, waste processing procedures, incineration facility available, waste
collection, transfer, disposal and general policy issues towards municipal solid waste
management. The other health data were collected from Primary Health Centres
(PHCs), Deputy Director of Health Service, Palayamkottai and Joint Directorate of
Health Service, Tenkasi and Directorate of Health Service, Chennai.

The knowledge review were collected from books, national and international
journals, reprints, monographs, working papers and various reports of national and
International organizations. Other than that some relevant sources has been collected
from Madras School of Economics (MSE), Chennai, Indira Gandhi Institute for
Development Research (IGIDR), Mumbai, Institute of Economic Growth (IEG), New
Delhi, Tata Energy Research Institute (TERI) New Delhi. Besides, the survey was
engaged with Contingent Valuation Method to ascertain the actual willingness to pay
to improve the solid waste management in Tirunelveli Corporation since
environmental services do not have markets. The CV method is a survey based
elicitation technique to estimate WTP values of a good that is not traded in the
conventional market. The CV method is often referred to as stated preference method,
in contrast to revealed preference methods, which use actual revealed behaviour of the
consumers in the market. The CV method directly asks consumers’ WTP for a non-
marketed good under a given condition or prescribed circumstances. To elicit
consumers’ WTP values for non-marketed goods, a hypothetical market scenario
should be formulated and described to the survey respondents. Thus, the elicited WTP
values of a good are “contingent upon” the hypothetical market prescribed in the
survey questionnaire.

Since a CV survey always asks WTP questions, it has been commonly called a
“WTP study”. Subsequently, the key fundamentals of “Contingent” market scenarios
are often overlooked by practitioners as the term “WTP” predominates over “CV
method”. In this research, WTP and CV method has been distinguished: WTP as a
concept referring to the economic value of a good, and CV method (replacing the
commonly called WTP study) as the survey based technique to estimate welfare loss
based on CVM models through various econometric regression models like Logit and
Tobit estimation.

Despite its wide use for practical policy purposes, the CV method’s ability to
reliably estimate WTP is not universally accepted. While some economists have
expressed skepticism on the use of direct questioning to estimate WTP, one of the
early verdicts on the soundness of the CV method came from a group of world
renowned economists: Kenneth Arrow, Robert Solow, Roy Radner, Edward Leamer,
and Howard Schumann (Arrow et al. 1993).

The CV method has improved significantly during the last 50 years. One of
the pioneers in the filed of CV surveys, Kerry Smith V. (2006), argues that CV
research has witnessed robust progress, enabling better understanding of consumer
preferences. More specifically, the progress of econometric analysis, survey research
methods, sampling and experimental design, and policy applications in the last 50 years has been remarkable. In Smith’s assessment, concerns relating to measurement bias in estimating non-use values can be excessive. However, similar measurement bias is a lesser concern because of estimation of direct use values. As Smith further elaborates, hypothetical bias can also be large because of the nature of CV surveys. Careful development of survey instruments (through initial preparatory work, focus groups, cognitive interviews, and pre-tests); conscientious implementation of field work; and rigorous econometric analysis that link the data to underlying theoretical models (e.g., utility functions) can help reduce hypothetically in a CV study.

Another important reason behind the expressed reservations about the CV method is the potential divergence between responses and actual behaviour. The emerging evidence shows that predictions from “hypothetical” CV scenarios seem to compare well with actual behaviour (Cameron et al. 2002, Vossler and Kerkvliet 2003). Moreover, Choe et al. (1996) show that WTP values from a stated preference model (CV method) is a robust as those from a revealed preference model (such as travel cost method). Finally, Smith (2006) contends that the CV method will remain a significant part of efforts to assess consumer preferences for non-market goods. Adamowicz (2004), Whitehead (2006), and Whitehead and Blomquist (2006) essentially endorse this view and maintain that CV studies remain a key tool in generating data on new (non-market) goods and services for policy analysis. Despite significant improvements in methodology, debate on the ability of the CV method to meaningfully measure WTP continues. Perhaps, due to lack of suitable alternative methods applicable within the resource and time limitations of many researches, the CV method is widely applied to estimate WTP. In this context, the pragmatic approach is to use the CV method meticulously, applying the improved methodology
to generate reliable estimate of WTP to improve solid waste management in the Tirunelveli Corporation limit.

**Contingent Valuation Method (CVM)**

Here, the researcher will use regression models in which the dependent or response variable itself can be dichotomous in nature. Basically, it is a ‘Yes’ or ‘No’ type answer receiving from the respondents with regard to improvement of Solid Waste Management in Tirunelveli Corporation. We use 1 or 0 value to measure this. In this question, some of the respondents are willing to pay and some are not. To estimate and infer problems, we will use Logit model. We have to classify all categories according to their actual contribution in terms of rupees to improve solid waste maintenance. To measure the actual contribution for the respondent’s solid waste improvement the researcher use Tobit model.

The specification of the Logit equation is,

\[
WTP = \alpha + \beta_1 \text{AGE} + \beta_2 \text{SEX} + \beta_3 \text{MS} + \beta_4 \text{INCOME} + \beta_5 \text{DIS} + \beta_6 \text{RUPWTP} + \beta_7 \text{HCOST} + \\
\beta_8 \text{WLOSS} + \beta_9 \text{PRIEDU} + \beta_10 \text{HEDU} + \beta_11 \text{Dedu} + \beta_12 \text{PRI} + \beta_13 \text{GOVT} + \beta_14 \text{BUSI} + \\
\beta_15 \text{QUAL} + \beta_16 \text{MQUAL} + \beta_17 \text{FAIRLY} + \beta_18 \text{HIGHLY} + U_i
\]

Where,

Dependent variable WTP = 1; if willing to pay for solid waste improvement= yes

= 0 otherwise

Dummy Independent variables (Description)

- $\beta_1$ = Age of the respondent (years)
- $\beta_2$ = 1 if Sex = Male, 0= otherwise
- $\beta_3$ = 1 if Married, 0= otherwise
- $\beta_4$ = 1 if Income earner, 0= otherwise
- $\beta_5$ = 1 if Distance is closer to Dustbin, 0= otherwise
\[ \beta_6 = 1 \text{ if Rupee Willingness to Pay, } 0 = \text{otherwise} \]
\[ \beta_7 = 1 \text{ if Health Cost is high, } 0 = \text{otherwise} \]
\[ \beta_8 = 1 \text{ if Wage loss, } 0 = \text{otherwise} \]
\[ \beta_9 = 1 \text{ if primary educated, } 0 = \text{otherwise} \]
\[ \beta_{10} = 1 \text{ if high school educated, } 0 = \text{otherwise} \]
\[ \beta_{11} = 1 \text{ if graduated, } 0 = \text{otherwise} \]

*Base Category – Illiterates (for education)*

\[ \beta_{12} = 1 \text{ if private employee, } 0 = \text{otherwise} \]
\[ \beta_{13} = 1 \text{ if govt. employee, } 0 = \text{otherwise} \]
\[ \beta_{14} = 1 \text{ if business, } 0 = \text{otherwise} \]

**Base category- Unemployed**

\[ \beta_{15} = 1 \text{ if SWM is poor, } 0 = \text{otherwise} \]
\[ \beta_{16} = 1 \text{ if SWM is fair, } 0 = \text{otherwise} \]

*** Base category- Very Poor

\[ \beta_{13} = 1 \text{ if the person is fairly accepted to improve Solid Waste, } 0 = \text{otherwise} \]
\[ \beta_{14} = 1 \text{ if the person is highly accepted to improve Solid Waste, } 0 = \text{otherwise} \]

****Base category – not at all interested to pay WTP for SWM

In addition to that, other information relating to economic costs like average wage days lost, number of hospital visits etc. to prevent illness from vector borne diseases were collected through sophisticated survey questionnaire. A household survey was conducted continuously for a period of six months from October 2010 to March 2011 to ascertain the real impact of solid waste problems cause various illness among the residents of the Tirunelveli Corporation.
Significance of the Study

The management of solid waste involves multiple storage process at the beginning stage as a source (primary storage or secondary storage), collection, transportation and final disposal of the refuse. There is no one best method of managing solid waste that can serve best all cities. One has to approach managing solid waste in an innovative manner since selection of the best device and practice at each stage depends on a variety of specific circumstances to the city under consideration. The factors include socioeconomic as well as the nature and volume of waste (UNEP, 1987). Poor solid waste handling is threatening the lives of inhabitants of Tirunelveli Corporation. To improve this pressing problem the local body together with all stakeholders has to put maximum effort. The problem is usually inadequate budget compared to solid waste generation in Tirunelveli Corporation. In this procession, it is very important and timely to look for the possibility of cost sharing by households, and for this we need to analyze the demand side for improved solid waste management. Therefore, this study is designed to generate demand side information, which is vital for the planning process for further development of municipal solid waste management.

Limitations of the Study

The major constraints and limits would be recorded by the researcher, especially on the reliability of WTP responses towards solid waste management partially biased due to poor knowledge of understanding about the environmental quality of the residents of Tirunelveli Corporation. The other major setback is that the paucity of Corporation data may not be feasible to understand the significance of solid waste problem among the public. Therefore, the researcher has met many hardships
to enlighten the issue meticulously to make understand the consequences of the impacts of improper solid waste management both by the Corporation as well as the residents of Tirunelveli Corporation. The study has taken a period of eight years from 2003 to 2010 and the field study was done during October 2010 to March 2011. However, the statement and result made out of the study is applicable exclusively to Tirunelveli Corporation.

**Outcome of the Study**

Solid waste generation is an unavoidable consequence of the consumption and production activities of a society. Proper handling of waste is becoming a serious problem of cities all over the globe especially in developing countries like India where financial and technical scarcity is very serious. Under this crucial juncture, the study would more concern on the demand side information from households who are the major generators and victims of improper handling of solid waste. From the analysis of household’s responses about their experience in handling solid waste, their perception and their willingness to pay for improved solid waste management, various inferences might have brought for policy implications. The central hypothesis is that the survey results of WTP should reflect the value to the community for having a better environmental quality assessed through Contingent Valuation Method of survey. The methodology has followed a direct questioning among the residents of Corporation for their willingness to pay (a fee) towards the costs incurred for proper solid waste management by the Corporation. The willingness to pay for solid waste management has been analysed through multivariate regression using econometric models like Logit and Tobit to estimate WTP ranges.
CHAPTERISATION

**FIRST CHAPTER** deals with an introduction of Solid Waste Management in general, objectives of the study, research methodology, Limitation of the study, and Outcome of the research.

**SECOND CHAPTER** portrays all relevant Literature with regard to Solid Waste Management and its Economic Valuation by using Contingent Valuation Method.

**THIRD CHAPTER** deals with Economics of Solid Waste Management in Tirunelveli Corporation

**FOURTH CHAPTER** reveals that the impact of MSW on health aspects of the residents of Tirunelveli Corporation

**FIFTH CHAPTER** deals with empirical analysis of Willingness to Pay to improve Solid Waste Management by using Contingent Valuation Method

**SIXTH CHAPTER** discussed whole summary of the chapters, Findings and Policy conclusions.